NATIONAL FIRE PROOFING COMPANY

We manufacture everything in the line of hollow tile fire-proofing material.
"If you don't see what you want, ask for it."

Terra Cotta
Hollow Tile Fireproofing

AS USED IN THE CONSTRUCTION OF

Standard Steel Frame
Fireproof Buildings

PUBLISHED BY

National Fire Proofing Company

Manufacturers of TERRA COTTA HOLLOW TILE

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Twenty-six Factories Throughout the United States

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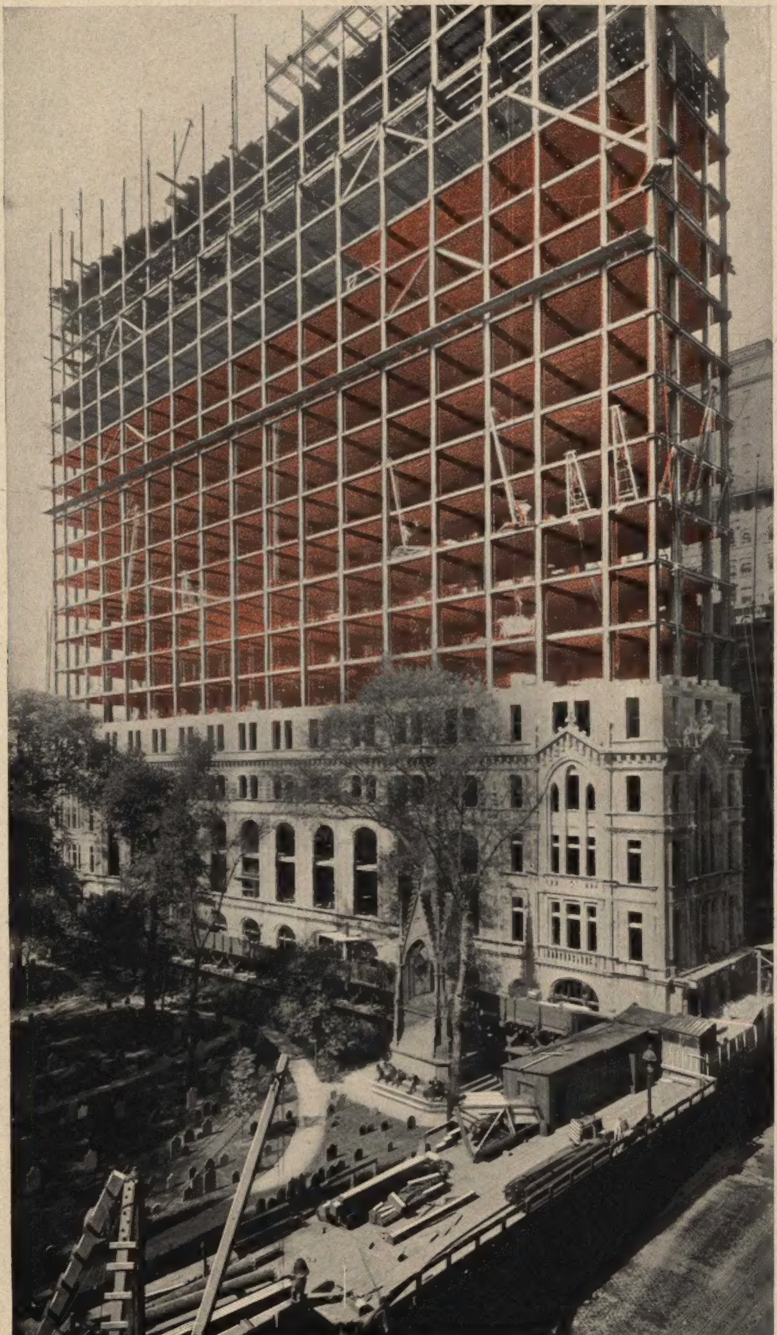
OLD SOUTH BUILDING, BOSTON, MASS.

Eastern Edition Catalogue



Trinity Building, 111 Broadway, N. Y.
Fire-proofed by National Fire Proofing Company

A BUILDING to be "fire proof" must be so constructed that it is not only non-combustible, but also that it will not be seriously damaged by the burning of its contents. Such buildings are commonly erected of brick walls and steel frame work. The floor framing of steel beams is filled in with flat or segmental terra cotta hollow tile arches which form the floors and ceilings and are designed to carry the superimposed load, prevent the spread of flames from story to story and protect the steel work from the action of fire.

If the beams are carried by brick walls the construction is termed "wall bearing"; if by interior and exterior steel columns, "skeleton construction."

The partitions, wall furring, flat and mansard roofs are constructed of hollow tile blocks, while the columns, girders and all structural steel are encased in them. The plastering is applied directly to the roughened surface of the blocks.

Photographs on opposite and 28th pages give a good idea of the methods employed. It will be seen that the arches are installed as rapidly as the beams are set and riveted. This facilitates all the other operations connected with the erection, and any system of floor arches that cannot be finished at the rate of about three tiers a week under ordinary weather conditions is a hindrance to rapid construction, and more costly in the end than hollow tile.

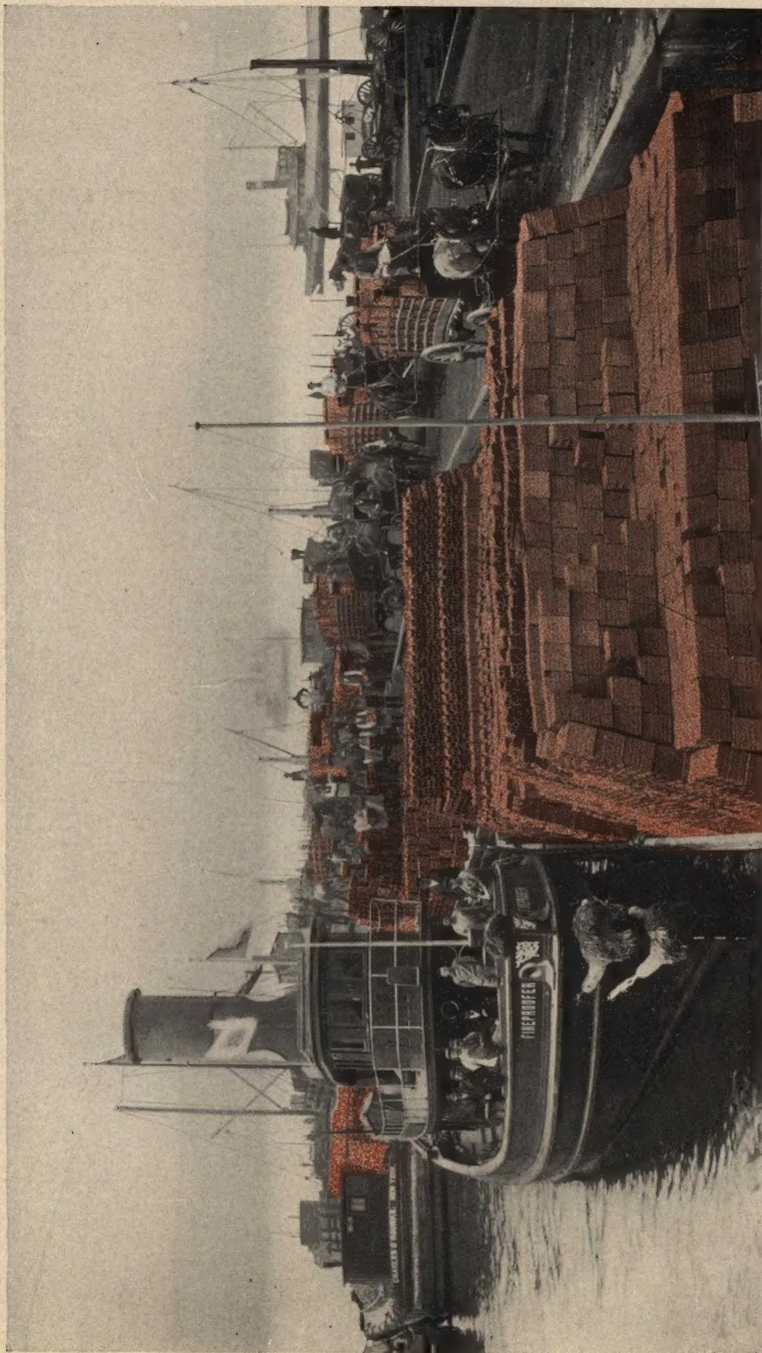
To those who are skeptical that one or two inches of terra cotta can protect the steel work, we would refer to the records of the Baltimore fire, which show that the damage to the structural steel in the Calvert Building was 1.37 per cent., Union Trust Building 1.03 per cent. It is possible by the use of proper methods and material to reduce the damage to nil.

In preparing this catalogue, it has been our aim to condense, within as small a space as is consistent with a clear presentation of the subject, all the data that an architect will ordinarily require in designing a thoroughly fire resisting building. We have not attempted to illustrate all the shapes of hollow tile material that it is possible to make, only the more commonly used forms having been shown. The sectional drawings show the possibility of securing different results by the combinations of various shaped blocks.

When stock material cannot be readily used, we will be glad to submit special detail drawings to meet existing conditions.

A few photographs of individual blocks have been introduced which give a clearer idea of their actual appearance than it is possible to convey by any other means.

After more than thirty years of use, hollow tile is still the acknowledged standard by which excellence in fire-proof



Showing Method of Transporting Material from Our Factories to Buildings in New York by Company's Tug, Barges and Trucks

construction is reckoned. So well known are its merits that it seems almost a waste of space to enumerate them. For the information of the young architect, however, who may be tempted to experiment with some of the many fads of the present day at the risk of his clients' money and his own reputation, we will simply mention some of the points wherein hollow tile excels.

1st. It is composed of clay which has been burned in a kiln at a temperature of from 2000° to 2500° Fahrenheit. A product of fire cannot readily be destroyed by fire, while all forms of concrete are injuriously affected by the application of sufficient heat, because the water, which has united chemically with the cement, is driven off and the mixture disintegrated.

2nd. It is not composed of a mechanical and chemical mixture of several constituents of variable degrees of freshness, strength and purity, which must be measured and mixed by unskilled workmen with more or less honesty and care, and left to harden under all sorts of weather conditions.

3rd. The architect can readily judge of the quality of hollow tile by its appearance. It must be set by skilled mechanics and cannot be mixed and wheeled into the building from a dark cellar and dumped into place, compelling him to trust to Providence that his specifications have been followed and that the floors will be all right.

4th. A cubic foot of hollow tile weighs about 40 pounds, while the same amount of the lightest cinder concrete, suitable for arches, weighs about 100 pounds.

5th. When hollow tile arches are built the key is set in place, thus strongly bracing that span, and when all are in position the building is made perfectly rigid. All forms of composition floors shrink more or less in setting and drying and in consequence they not only load the frame with an inert mass, but add nothing to its stiffness.

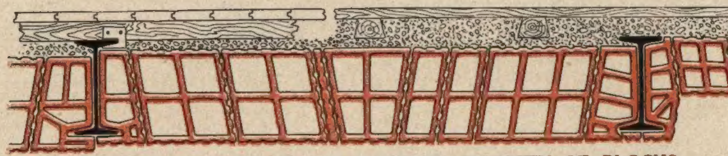
6th. Hollow tile is not only absolutely fire proof, but also more nearly sound proof than any solid construction can be.

7th. The structural steel work must be preserved from corrosion. Hollow tile arches are set in Portland cement mortar, which is the best rust preventative known. All cinder concrete and other composition floors contain ingredients injurious to steel and in some instances the deterioration from these causes is very rapid.

Hollow tile blocks should be made of a good refractory clay and be of either "dense," "semi-porous" or "porous" material.

The porosity of terra cotta is produced by mixing sawdust with the raw clay. During the burning process the sawdust disappears, leaving small cavities where it had been. Porous terra cotta is a better fire and water resisting material than dense or semi-porous, but it has not as great strength, therefore, dense or semi-porous material is used for arches; dense, semi-porous or porous for partitions and furring; semi-porous or porous for column and girder covering and for roof blocks. To obtain the

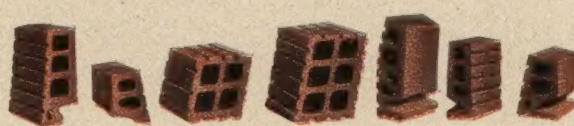
SIDE CONSTRUCTION FLAT ARCHES



SECTION THROUGH FLOOR SHOWING VARIETY OF BLOCKS

For weights of arch see below. Weight of cinder concrete fill, about 60 pounds per cubic foot. Weight of maple floor, 3½ pounds per square foot. Weight of sleepers, about equal to weight of cinder concrete. Weight of two coats plastering, 5 pounds per square foot.

PHOTOGRAPHS OF TYPICAL BLOCKS



Skew for Soffit Slab — Plain Skew — Lengtheners — Raised Skew — Skews with Protection Lip

Key

Note: Any span between beams can be filled by using combinations of proper sizes of blocks.

Keys

TABLE OF WEIGHTS, ETC.

Depth of Arch Inches	Weight, Pounds per Square Foot	Spans Allowable Between I Beams	
		Arch Set Flat Feet and Inches	Set with Slight Camber Feet and Inches
6	24 to 26	4-0	4-6
7	26 to 28	4-6	5-6
8	27 to 32	5-0	6-0
9	29 to 36	5-6	7-0
10	33 to 38	6-6	7-6
12	37 to 44	7-0	8-6

Note: The heavier weights are the ones commonly used. The lighter weights can be made if required. See note under table on page 10 for ordinary and maximum spans. See table on pages 32 and 33 for strength of arch of various spans.

Perspective of Typical Arch

best results in a building, it is not only necessary to have good material, but it should be properly set by skilled mechanics under expert supervision. We have a thoroughly equipped construction department and are prepared to execute entire fire proofing contracts or will supply the material to the mason contractor, when so desired.

Our factories are located near all the great centers of population, where prudence and true economy have clearly demonstrated the necessity for fire proof buildings. We have, by far, better facilities for the manufacture, delivery and erection of hollow tile fire proofing than any other manufacturer. In New York and where necessary we have our own tugs, fleet of barges, horses and trucks, thus being able to control the delivery of our material at every stage, from clay bank to building. When a steel skeleton building is rising at the rate of three or four tiers a week and the floor arches must keep pace with steel work, prompt and certain delivery of material is vital to the rapid completion of the structure. *Delay of a few weeks often means loss of the rent of a building for an entire year.*

The services of our corps of engineers are always at the disposal of those who are interested in the design and construction of fire-proof buildings and estimates of the cost of the work will be cheerfully given.

FLAT ARCHES FOR FLOORS AND ROOFS

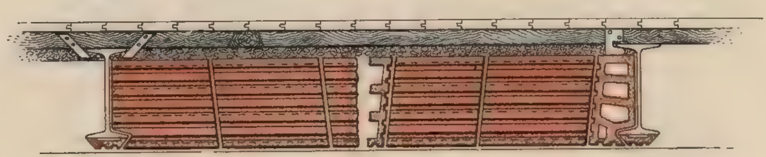
SIDE CONSTRUCTION

FLAT arches are made up of various shaped blocks, as shown in the drawings and photographs. The blocks resting against the beams are called "skews" and may be either "plain" (without protection on the under side of the beam), "lipped" (having the protection moulded on the block), or "soffit" skews (where the protection is a loose slab held in place by the bevel on the blocks). The intermediate blocks are called "lengtheners," and the center one the "key." The blocks are set breaking joints.

There is shown on opposite page typical sections illustrating the methods of assembling the various members of the arch. The depth of the arch must be proportioned to the span between the beams and to a certain extent to the load to be carried. Safe loads of various spans of ordinary material are given in table on pages 32 and 33.

A safe general rule for finding the proper depth of the arch in inches is to multiply the spans in feet by 1¼ inches, and add the thickness of the protection below the beams. The present building law, however, in New York City requires the depth to be 1¾ inches per foot of span, but this is excessive except for very heavy loads or unusually light material. The webs should

END CONSTRUCTION FLAT ARCHES

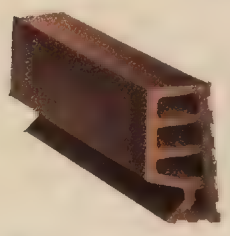


End Construction Throughout   Combination Side and End Construction

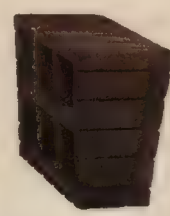
SECTION THROUGH TYPICAL FLOOR

To find total dead load of any floor use the following weights: Tile, rock asphalt or cement finish weighs about 140 pounds per cubic foot; wood flooring, 3½ pounds per square foot; wood sleepers, 25 pounds per cubic foot; cinder concrete fill, 60 pounds per cubic foot; T. C. arch, see table below; plastering, 5 pounds per square foot; steel I, divide weight of beam by span in feet.

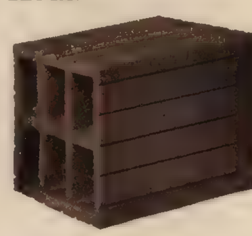
PHOTOGRAPHS OF TYPICAL BLOCKS



Side Construction Skew for Soffit Slab



Key

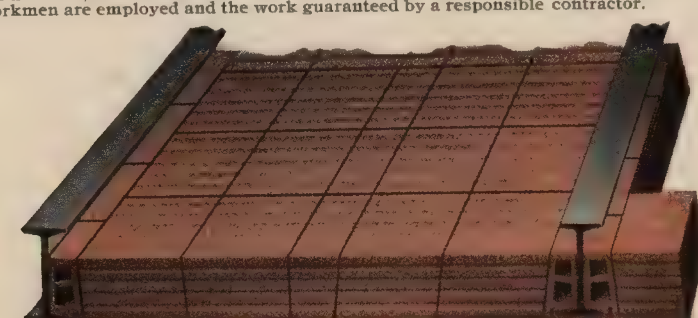


Lengthener

TABLE OF WEIGHTS, ETC.

Depth of Arch Inches	Weight, Pounds per Square Foot	Spans Allowable Between I Beams	
		Arch Set Flat Feet and Inches	Set with Slight Camber Feet and Inches
6	20 to 26	4-6	5-0
7	22 to 29	5-0	5-9
8	24 to 32	5-6	6-6
9	26 to 36	6-0	7-0
10	28 to 38	6-6	7-6
12	30 to 44	7-6	9-0
15	37 to 50	9-0	10-0

Note: The strength of any arch depends as largely upon the workmanship as upon the material, therefore the maximum spans given can only be used where experienced workmen are employed and the work guaranteed by a responsible contractor.



Perspective of Typical Arch

be not less than ⅝ inch thick and all beams covered where exposed to the action of fire by at least one inch of material.

If wooden flooring is used over the arches the space between the sleepers up to the underside of the flooring should be filled with concrete, made of broken tile, or cinders, sand and cement. Under no circumstances should this space be left open for the free circulation of fire.

Where a paneled ceiling effect can be permitted, the dead weight of cinder fill over the arches can be frequently reduced by using raised skewbacks, thus raising the top of the arch level with top of beams. Where head room is the great consideration and no great heat possible in case of fire, plain skewbacks (without the beam protection) may be used, but not otherwise.

"Radial joints" are sometimes specified but should be avoided, as they entail needless expense in manufacture and endless confusion and delay in setting, without any compensating advantages.

The line of greatest pressure in a flat arch is near the top of the key and bottom of the skewback. Note faulty construction of skew shown. It should have member shown in dotted lines to oppose the thrust near the bottom. This is of the utmost importance, but is frequently omitted in the endeavor to reduce weight. Arches have collapsed from this cause alone.

FLAT ARCHES FOR FLOORS AND ROOFS

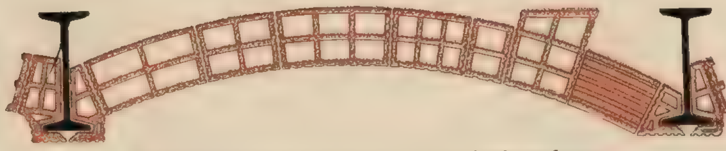
END CONSTRUCTION

THIS type of arch has been growing in popular favor until now fully 75 per cent. of all material used is of this form. If properly set it will develop about 50 per cent. more strength for the same weight than the side construction. Theory and tests prove this to be true. The objection urged against this construction is that it is wasteful of mortar and difficult to get the edges of the blocks properly bedded. They do require slightly more mortar, but the second objection is not serious, for, if the blocks are cut to a proper bevel, the tighter they are set the stronger the arch.

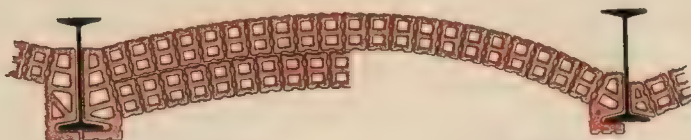
We recommend the use of heavy side construction skews and keys with the end construction lengtheners. By reversing the direction of the cavities in the skews, better protection is given to the sides of the beams by the mortar joints and by the webs of the skews.

The arch blocks must be set end to end in straight courses from beam to beam, and cannot be set breaking joints as in the side construction method.

SEGMENTAL ARCHES—TYPICAL SECTIONS

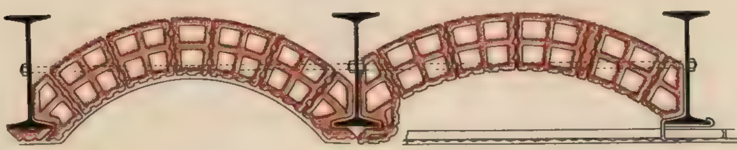


Section Showing Various Styles of Skewbacks and Keys



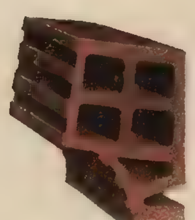
Double Rowlock Arch — Single Rowlock Arch

Segmental Arches of "Haverstraw" Hollow Brick

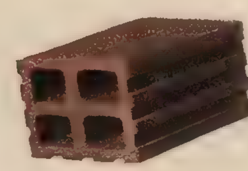


Showing Plastering on Arches — Showing Use of Metal Lath Ceiling

PHOTOGRAPHS OF TYPICAL BLOCKS



Skewback for 6-inch Elliptical Arch



Key for 6-inch Segmental Arch

Skewback for 6-inch Segmental Arch

Weight of ordinary 4-inch solid brick segmental arch, 38 pounds per sq. ft.
Weight of ordinary 8-inch solid brick segmental arch, 80 pounds per sq. ft.
Weight of ordinary 4-inch H. H. B. segmental arch, 31 pounds per sq. ft.
Weight of ordinary 8-inch H. H. B. segmental arch, 65 pounds per sq. ft.
Weight of ordinary 6-inch hollow tile segmental arch, 27 pounds per sq. ft.
Weight of ordinary 8-inch hollow tile segmental arch, 33 pounds per sq. ft.

For table giving safe loads for various spans and different rise of arch, see page 35.

SEGMENTAL ARCHES

THIS form of arch is the strongest and cheapest possible. It is particularly adapted to warehouses, lofts, factories, sidewalks, or wherever great strength is required and a flat ceiling is not necessary. They are made of hollow brick, "Haverstraw" size, or of 6-inch or 8-inch hollow tile. In driveways, where heavily loaded trucks and teams will pass over them, the double rowlock hollow brick arch is preferable, but where the loads will not be excessive the other forms shown are better because they are amply strong and, being much lighter, a lighter I beam can be used with consequent saving.

An elliptical arch, with raised skewback at the beam, reduces the amount of the concrete fill at the haunches and lessens the dead load, but the large skewbacks are slightly more expensive than the smaller ones used with the circular segment.

Where a very light, strong arch is required in deep beams, and a flat ceiling is also demanded, this result can be obtained by using a metal lath ceiling suspended below the beams. This form has been used for years almost exclusively in the New York Public School buildings. There is shown on opposite page several types of arch in general use. The large blocks with large openings are lighter and cheaper to lay than the smaller ones. The skewbacks showing rounded surface under the beams are cheaper to plaster than where an arris is used. By raising the arch at the skewback the arch is flattened and the dead load of concrete at the haunches is reduced, as is also the strength of the arch. End construction blocks may be used, but they are unsatisfactory unless the arches are of uniform span and rise throughout. The rise of the side construction arch can be varied by increasing the thickness of the upper or lower part of the mortar joint, but this cannot be done with the end construction method. The raised block shown in upper arch on opposite page has been used in very wide spans, its object being to bring the concrete back of it in compression and to relieve to some extent the pressure on the skewback.

The most effective location for the tie rods to counteract the thrust is near the bottom of the beams. They may be placed there and painted, or set higher and protected by the arch. If this is done the rods in the end spans should be made forked or double rods set crossing. The table on page 35 gives the strength of various thicknesses of arches for different spans and rise.

The 6-inch arch is used for all ordinary purposes, and is as strong as the 8-inch of equal rise and thickness of webs.

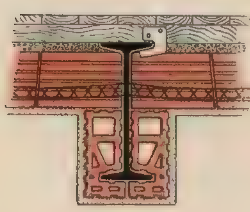
"NEW YORK" REINFORCED TERRA COTTA ARCH

BEVIER PATENT

Weight of 6-inch Arch 23 Lbs. per Sq. Ft.

Soffit Skew — Plain Skew

The New York Bureau of Buildings has approved the 6-inch arch for live load of 150 pounds per square foot for spans up to 6 feet between beams, and 8-inch arch for spans up to 7 feet 6 inches.



Section showing Raised Arch in Deep Beams, giving Paneled Ceiling

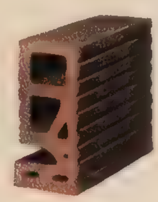
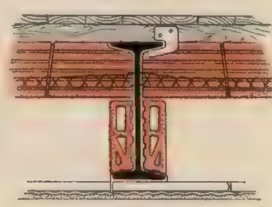


Photo of Beam Block



Section showing Raised Arch in Deep Beams with Metal Lath and Plaster Ceiling

6-inch Arch — Section through Arch Parallel to Beams — 8-inch Arch

Wire Truss Reinforcement

Reinforcement may be used with any blocks

"NEW YORK" REINFORCED TERRA COTTA ARCH

BEVIER PATENT

THIS arch was designed for use where a light and cheap, but strong floor construction with a flat ceiling is required, and is particularly adapted to wide spans in shallow beams. Where light floor construction with deep beams is necessary it can be secured by setting the blocks level with the top of the beams and using a flat metal lath ceiling, or by omitting the ceiling, a paneled effect is obtained. This is lighter, but not as strong as the segmental arch previously described.

Where shallow beams are used the blocks are set level and one inch below the bottom of the beams. Light cinder concrete or dry cinders is used to level up to the top of the beams.

This is the ideal construction for hotels, residences, libraries, and wherever an extremely light, strong, sound-proof and fire proof floor is required at a low cost.

It is lighter than any other system of hollow tile or concrete construction now in use and can be erected at a cost to compete with systems of inferior merit.

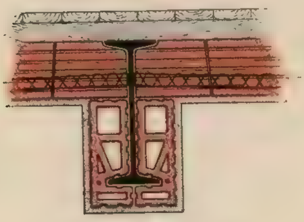
The wire truss reinforcement used in this system is shipped to the building in reels, and is cut to proper length on the job as required, so there is no delay in not being able to get the proper lengths. It is embedded in Portland cement mortar, which is the best rust preventative known for steel, and between the blocks, where it is protected from the heat in case of fire. The open-work construction of the wire truss enables the mortar to flow freely all about it and the joint can be thoroughly filled between the blocks and the wire perfectly embedded. This is not possible where any form of solid bar is used.

The 6-inch arch for 6-foot span and 8 inch arch for 7-foot 6-inch span have been tested by the Bureau of Buildings of New York and accepted for live load of 150 pounds per square foot.

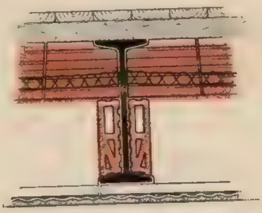
The "New York" arch has been successfully used in a number of large buildings in New York, and its merit fully demonstrated. Load tests were made to determine the ultimate strength of the 6-inch arch on a 6-foot span, and it was found to be 1600 pounds per square foot. This gives a safe live load of over 250 pounds per square foot, with a factor of safey of six.

By a proper proportioning of the size of the metal reinforcement and the depth of the blocks we can design floors to meet almost any requirement as to span and load.

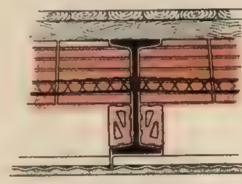
The weights of complete floors given below are based on following weights per square foot: 1-inch maple flooring at 3.5 pounds; 2 x 4-inch spruce sleepers, 16-inch centers and 2-inch cinder concrete filling between sleepers at 8.5 pounds; 6-inch arch blocks and mortar joints at 23 pounds; cinder concrete at 60 pounds per cubic foot; metal lath and plaster ceiling at 10 pounds; plaster ceiling on T. C. arch, 5 pounds; dry cinders, 48 pounds per cubic foot. Weight of beam included.



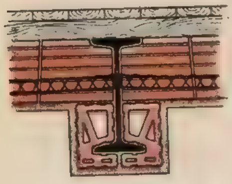
52 Pounds per Square Foot
15-inch I Beam



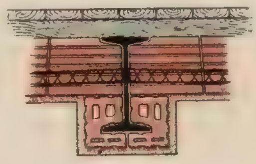
56 Pounds per Square Foot
15-inch I Beam



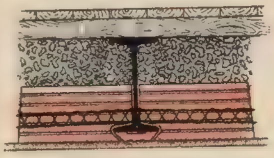
54 Pounds per Square Foot
12-inch I Beam



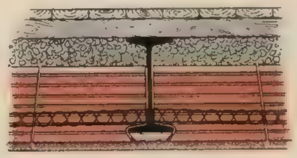
50 Pounds per Square Foot
12-inch I Beam



47 Pounds per Square Foot
10-inch I Beam



64 Pounds per Square Foot
10-inch I Beam

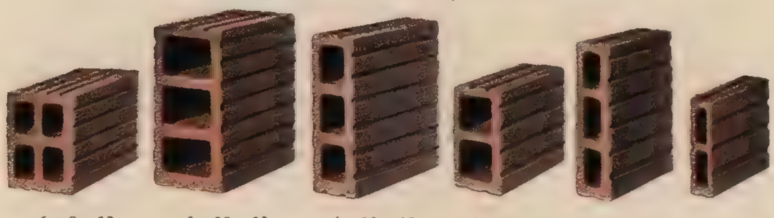


58 Pounds per Square Foot
10-inch I Beam, 8-inch Arch

The following are weights of floors complete where arches are set 1 inch below bottom of I beams and filled over arch to top of beams with dry cinders, with cinder concrete between sleepers: 15-inch I using 8-inch arch, 80 pounds per square foot; 12-inch I using 8-inch arch, 67 pounds; 6-inch arch, 73 pounds; 10-inch I using 8-inch arch, 58 pounds; 6-inch arch, 64 pounds; 9-inch I using 8-inch arch, 54 pounds; 6-inch arch, 60 pounds; 8-inch I using 8-inch arch, 49 pounds; 6-inch arch, 55 pounds; 7-inch I using 8-inch arch, 44 pounds; 6-inch arch, 51 pounds; 6-inch I using 6-inch arch, 47 pounds.

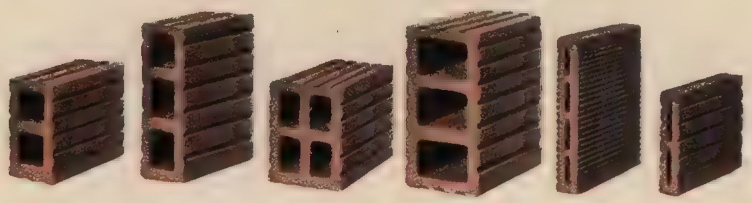
Central Park Studio Building. "New York Arch"

SEMI-POROUS PARTITIONS



6 x 8 x 12 · 6 x 12 x 12 · 4 x 12 x 12 · 4 x 8 x 12 · 3 x 12 x 12 · 2 x 8 x 12

POROUS PARTITIONS



4 x 8 x 12 · 4 x 12 x 12 · 6 x 8 x 12 · 6 x 12 x 12 · 2 x 12 x 12 · 2 x 8 x 12

STOCK SIZES

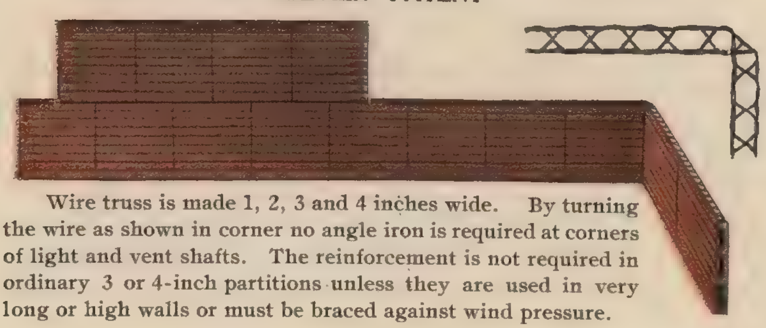
2 Inches	3 Inches	4 Inches	5 Inches	6 Inches
2 x 6 x 12	3 x 6 x 12	4 x 6 x 12	5 x 8 x 12	6 x 8 x 12
2 x 8 x 12	3 x 8 x 12	4 x 8 x 12	5 x 12 x 12	6 x 12 x 12
2 x 12 x 12	3 x 12 x 12	4 x 12 x 12		

WEIGHTS, PER SQUARE FOOT

	2-inch	3-inch	4-inch	5-inch	6-inch
Semi-porous	12 pounds	15 pounds	16 pounds	18 pounds	24 pounds
Porous	14 pounds	17 pounds	18 pounds	20 pounds	26 pounds

"NEW YORK" REINFORCED PARTITION

BEVIER PATENT



Wire truss is made 1, 2, 3 and 4 inches wide. By turning the wire as shown in corner no angle iron is required at corners of light and vent shafts. The reinforcement is not required in ordinary 3 or 4-inch partitions unless they are used in very long or high walls or must be braced against wind pressure.

PARTITIONS

THE recent fires in Baltimore and Rochester proved beyond the shadow of a doubt that hollow tile partitions are the only ones that will withstand a great conflagration. Where they were properly built upon the fire-proof arches or steel beams, laid with cement mortar and wedged against the floor arches at the ceiling above, they stood intact, while all forms of plaster blocks crumbled into rows of rubbish and metal lath partitions twisted into scrap iron.

In addition to the fire-resisting qualities of hollow tile partitions, they are light, strong, easily erected by bricklayers, and do not transmit heat, cold or sound.

About 15 per cent. of the quantity of blocks required should be of full porous material for nailing the wood trim. In school houses, where blackboards have to be fastened on the walls, all of the blocks should be full porous. These are slightly more expensive, but make a better partition for any purpose. All partitions and furring blocks, unless otherwise specified, are scratched to receive plastering. If the surface is to be white-washed the blocks are made smooth.

Wood or channel-iron bucks are placed in all doorway openings. These should be 1½ inches wider than the thickness of the blocks and act as grounds for the plastering.

It is not generally practicable to use 2-inch blocks for partitions, except for closets, shafts, etc., unless they are reinforced by metal. Where room must be economized we suggest the use of the "New York" Reinforced Partition, using 2-inch partition blocks with the truss wire in the horizontal joints. This is cheap and effective.

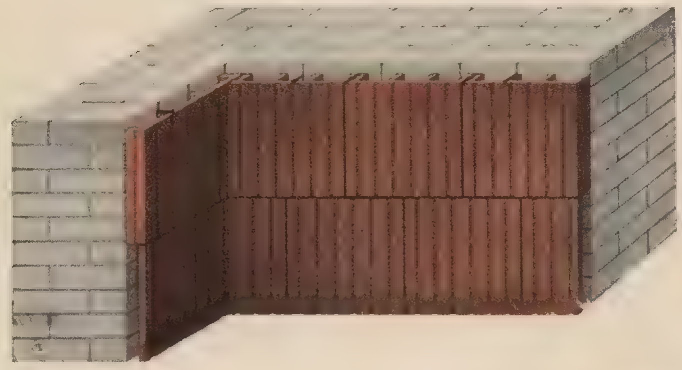
Three-inch partition can be safely used up to 12 feet in height, 4-inch to 16 feet, and 6-inch to 20 feet.

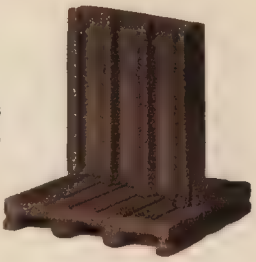
The blocks are commonly made 12 inches high by 12 inches long, although some prefer to have them 8 inches high. They can be made any size required, but special sizes are necessarily more expensive.

In office buildings it is good practice to have all the main corridor and stairway and elevator enclosures of 4-inch, and the partitions between rooms 3-inch. Partitions should be bonded where meeting and anchored to wood bucks or brick walls by using tenpenny nails, at least, in each second joint.

Blocks should be set on end, except top course, which may be set on side. When required for outside walls exposed to the weather the blocks must be specially made of dense material, hard burned. They may be made smooth on outside face and do not require plastering. If, however, a better architectural effect is desired, they are deeply grooved and given a coat of Portland cement stucco finish. They should not be less than 6 inches thick unless reinforced.

TERRA COTTA WALL FURRING

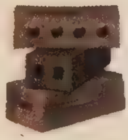




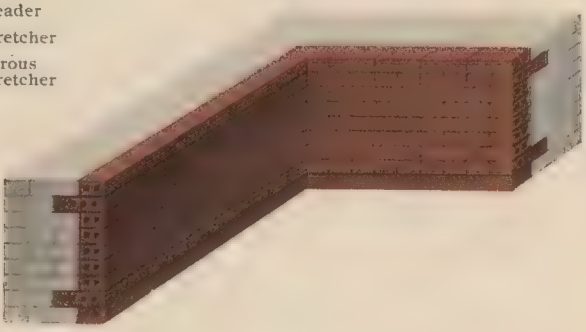
STOCK SIZES

1½ x 12 x 12 inches, weight per sq. ft. 9 pounds
2 x 12 x 12 inches, weight per sq. ft. 10 pounds

HOLLOW BRICK (HAVERSTRAW SIZE) FOR WALL FURRING



Header
Stretcher
Porous Stretcher



STANDARD SIZE

Stretcher, 2⅛ x 3½ x 8 inches	weight, 3 pounds
Header, 2⅛ x 3½ x 7¼ inches	weight, 2½ pounds
Porous stretcher, 2¼ x 3¾ x 8 inches	weight, 2½ pounds
Solid porous stretcher, 2¼ x 3¾ x 8 inches	weight, 3⅓ pounds

WALL FURRING

BRICK walls exposed to the weather must be furred to prevent dampness reaching the interior and destroying the plastering. For this purpose furring blocks of dense, semi-porous or porous terra cotta are used.

The blocks are made either 1½ or 2 inches thick and 12 inches square. The ribs being set against the wall, an air space is formed which effectively checks the passage of moisture. They should be set with the ribs vertical and fastened to the wall by driving tenpenny nails in the joints of the brickwork, the head of the nail being bent down upon the tile, using a nail over every third block in every second course. The blocks should not be bedded in mortar at the back since this would defeat their purpose by making a solid connection to carry the moisture through.

Where walls must be straightened or furred out to line with the face of piers the 2-inch blocks cannot be used. If the ceiling height is not too great use 3-inch partition blocks. If the space is greater than 3 inches the blocks may be set out from the wall leaving a clear air space behind them. They should be braced at intervals by the use of drive anchors or 4-inch blocks can be used without the anchors.

The face of the blocks is grooved so that the plastering is applied directly upon the blocks.

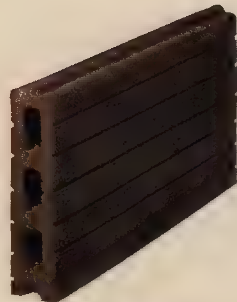
This form of furring is the most effective and at the same time the cheapest and most durable of any fire-proof system.

If any form of metal lath furring is used against exposed walls it will be destroyed by rusting in a few years, and its renewal will be very costly, especially where walls are decorated.

"HAVERSTRAW HOLLOW BRICK"

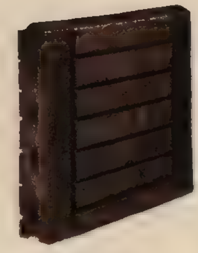
Where walls are not exposed to driving rain storms, as in courts or on the south side, or where the walls are more than 16 inches thick, they may be furred with hollow brick made of the same size as common brick. The building law of New York allows them to be included as part of the thickness of the wall. They cost very little more than rough brick, make the cheapest form of furring and are sufficiently effective to use in walls of warehouses, factories, etc. The headers are made as shown on the opposite page.

Porous bricks are made which will receive and hold a nail and are used where trim must be secured to the brickwork.



3-inch Porous Book Tile
Roof Block

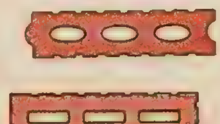
3-inch Porous Book Tile
Ceiling Block



2-inch Dense Book Tile
Ceiling Block

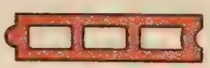
STANDARD SECTIONS

3-inch Porous Book Tile



3-inch Porous Ceiling

2-inch Porous Ceiling
Book Block



3-inch Semi-porous
Book Tile

3-inch Semi-porous
Ceiling

2-inch Semi-porous
Ceiling B. T.

STANDARD SIZES AND WEIGHTS

Roof Blocks, Inches

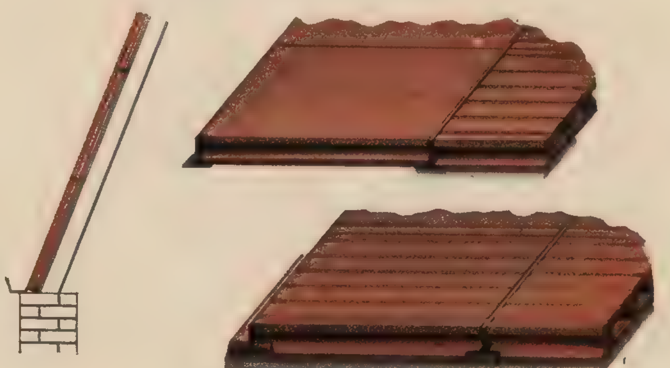
3 x 12 x 18 . .	20 lbs. per sq. ft.
3 x 12 x 20 . .	20 " " " "
3 x 12 x 24 . .	20 " " " "
4 x 12 x 24 . .	22 " " " "

Ceiling Blocks, Inches

3 x 12 x 16 . .	20 lbs. per sq. ft.
3 x 12 x 18 . .	20 " " " "
3 x 12 x 20 . .	20 " " " "
3 x 12 x 24 . .	20 " " " "

Ceiling Blocks, Inches

2 x 12 x 16 . .	12 lbs. per sq. ft.
2 x 12 x 18 . .	12 " " " "
2 x 12 x 20 . .	12 " " " "



Roof and Ceiling Blocks

ROOF AND CEILING BLOCKS

ON account of their shape resembling a book these blocks are also called "Book Tile."

Where the roof is to be nearly flat and covered with concrete or tar and felt roofing they are commonly made of semi-porous material either 3 or 4 inches thick, according to the weight to be carried. Three inches is generally sufficient.

If the roof is to have considerable pitch, as in mansard roofs, or wherever slate or roofing tiles must be nailed upon them they should be 3 inches thick and full porous, their exterior webs to be not less than 1⅛ inches thick.

Care should always be used in the specifications for the steel frame work to call for the spacing of T's, to be 1 inch wider than the length of the blocks; for example, for blocks 24 inches long the T irons should be spaced 25 inches on centers. This is the spacing most commonly used.

Wherever the blocks are not to be plastered on the inside or the T's protected, the blocks may be cut square at their ends and be laid upon the flanges of the T's, but where the blocks are to be plastered they must be rabbeted so that the bottom of the block will drop a little lower than the flange. If the flange of the T is narrow the plaster will cover it without trouble, but where the flange is of considerable width it should be wrapped with metal lath before the blocks are set. If 4-inch blocks are used they may be rabbeted so that they drop 1 inch below the flange, and a soffit cover used as in arches.

Roof blocks are useful for covering the flat roofs of pent houses, bulkheads, etc., but should seldom be used for the main flat roof of a building. The T irons, book tiles, wire lath protection of T's and beam protection together make a less satisfactory roof than the I beam and flat arch roof.

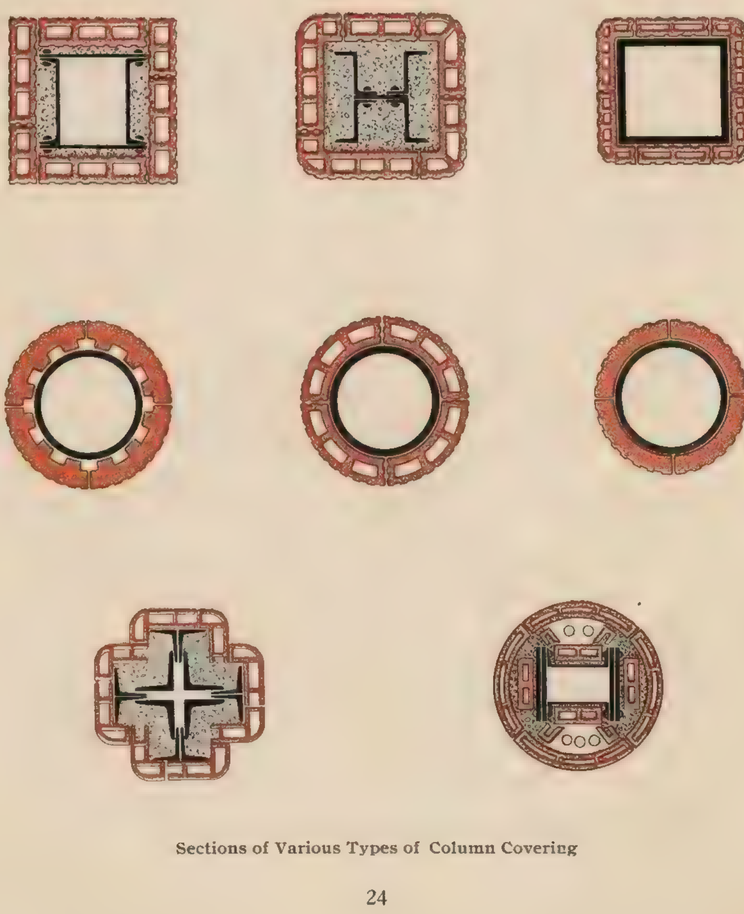
Where provision is made for future increase of height of the building, the flat arches are put in as for a floor and the roof grading and construction may be put in with T's and book tile.

There is really no difference between roof blocks and ceiling blocks. Roof blocks are seldom rabbeted, ceiling blocks generally are.

Wooden beams over boiler rooms are frequently fire-proofed by using 2-inch ceiling blocks secured to the under side of the beams by screws and washers. This method is approved by the New York Tenement Commission.

COLUMN COVERING

Photographs of Round Column Covering



Sections of Various Types of Column Covering

COLUMN COVERING

EXPERIENCE has demonstrated beyond question the necessity for thoroughly protecting the cast-iron or steel columns supporting walls or floors, and that porous terra cotta is the most efficient material for this purpose. It should be at least 4 inches thick. It being difficult to set the blocks true without some lateral support, where an air space is required next to the iron, they are made with lugs on the inside, which rest against the column.

Square columns are commonly encased in square coverings made of partition blocks set breaking joints. If round corners are required they may be made in a variety of ways.

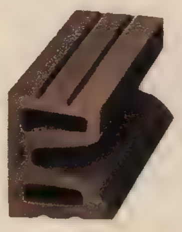
Cuts on opposite page show methods commonly used.

Columns should be covered independently of any piping which may be carried alongside of them. These should be provided for in a separate chase, built outside of the covering. Avoid, if possible, straight vertical joints in setting, but if it is not possible to break joints then the blocks should be bound together with metal clips and by wrapping with wire.

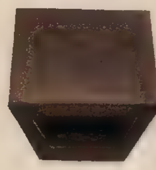
Particular attention should be given by the architect to see that the column covering is properly applied.

A low rate of fire insurance can not be secured if the columns are not properly protected, as the durability of the entire building is dependent upon the integrity of the columns. The space between the hollow tile blocks and the steel should be filled with concrete or cement mortar. This prevents the possibility of corrosion and gives additional security against fire.

GIRDER COVERING

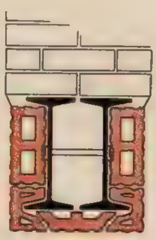


Semi-porous "Clip" Tile



Soffit Tile

Porous "Clip" Tile



Double Beam Girder Supporting Brick Wall

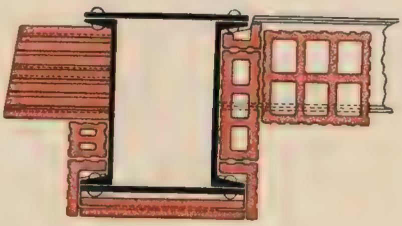
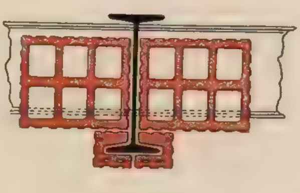
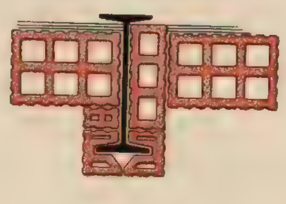


Plate Girder Protection Hung on Metal Clips





GIRDER COVERING

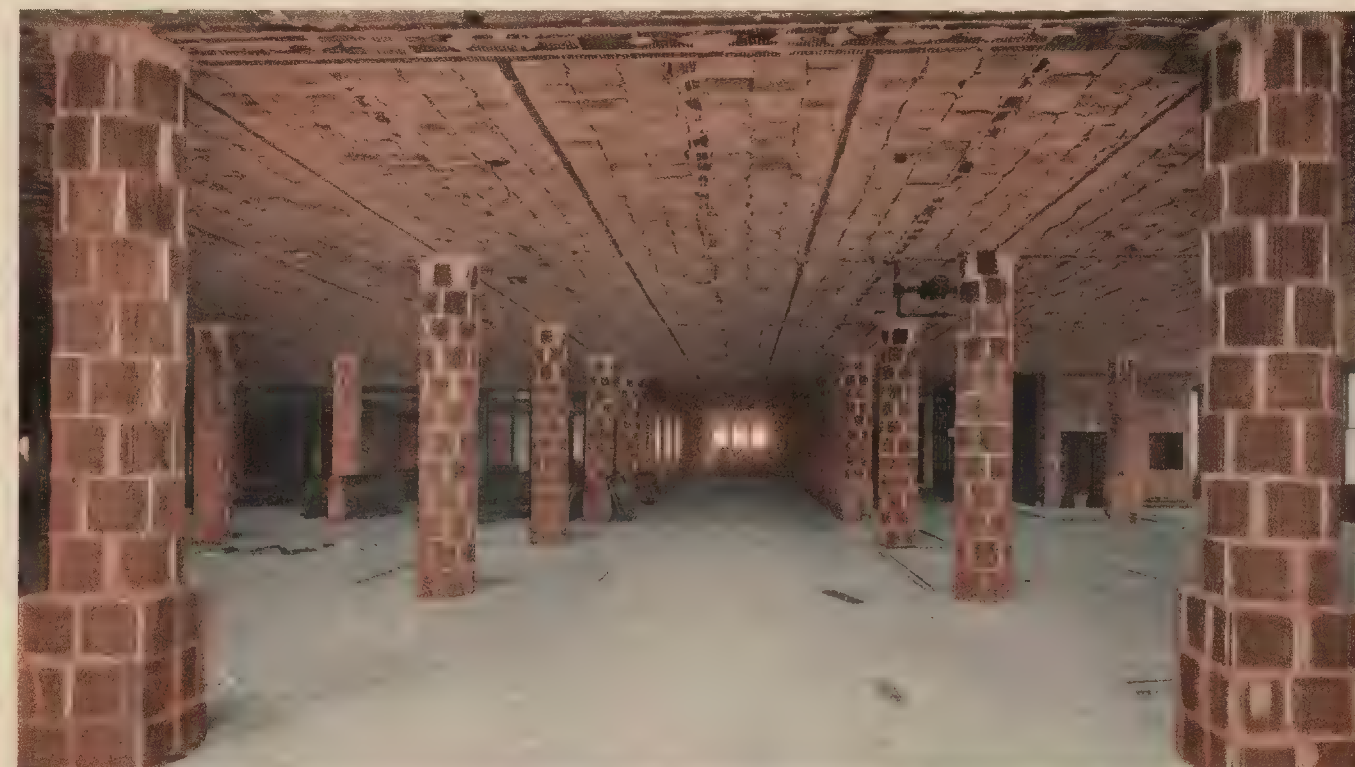
IT is necessary that girders projecting below the ceiling be protected by at least two inches of terra cotta. Those framed level with the floor beams may be covered by the same amount of terra cotta as used to cover the beams. If heavy plaster cornices are used the girders are protected first by the terra cotta, and the shape required for the plastering is obtained by iron brackets and metal lath, but this latter is not sufficient protection alone.

Experience has proven that porous terra cotta has no equal as covering for structural steel or iron, as it is the best non-conductor of heat, and is not destroyed by the action of fire and water. In case of a serious fire the integrity of the whole structure depends upon the thorough protection of the columns and girders, and no reasonable expense should be spared to accomplish this.

The lower flanges of the beams are usually covered by "clip tiles" and the webs by partition blocks, as shown. Where double beams are used the soffits are covered by a "soffit tile" fitting into the bevel of the clip tiles. For plate girders and where the space is wide the soffit should be hung on metal clips, which are protected, as shown in cut.

The girder covering may be set with the arches or later. If set with the arches, the partition block which rests upon the clip tile is held in place by the arch. If set later the space between the clip tile and the bottom of the arch is filled by a low block or hollow brick. The two methods are clearly shown on opposite page.

Channel beams should never be used except against brick walls, as it is almost impossible to properly protect them except at a greater expense than I beams would cost.



View of a typical floor of a fire-proof building, showing the unplastered hollow tile floor arches (in the ceiling) column covering and partitions. Also the cinder concrete sleeper fill on the floor

SPECIFICATIONS FOR STANDARD HOLLOW TILE FIRE-PROOFING

GENERAL

The contractor for this work will be required to furnish all the material and labor of every description required to erect the same in place complete. The contractor is referred to the plans and details for the general construction, and especially the steel diagrams and details showing connection between the structural steel and tile work.

DETAILS

When requested to do so the contractor shall furnish large scale details or full-sized drawings for all special shapes, column coverings, lintel covers, girder covers, and general type of arch; which shall be submitted to the architects for their approval.

SPECIAL SHAPES

The contractor shall furnish all necessary special shapes for the proper fitting to the steel work.

SCAFFOLDING, TOOLS, ETC.

Furnish all the tools, machinery, hoisting apparatus and centering, necessary to carry on the work at the rate of progress stipulated in the contract.

TILE

All the tile required for this work shall be of the best quality of hard-burned fire clay, semi-porous, or porous terra cotta. This tile to be well manufactured. No badly split, cracked or warped tile will be permitted to go into the work. Material to be equal to that manufactured by the National Fire Proofing Company.

MORTAR AND LAYING

All the tile work for the floor construction shall be laid in mortar composed of one (1) part American Portland cement, of approved brand, three (3) parts sharp sand and one (1) part lime mortar, all thoroughly well mixed together as follows: The sand and cement are to be mixed together dry, and sufficient water added to thoroughly wet same, after which the lime mortar is to be added and the whole mass is then to be thoroughly tempered. All other tile work is to be laid in mortar composed as follows: One (1) part Louisville, Rosendale, or other natural cement, three (3) parts sharp sand and one part lime mortar, thoroughly mixed in the manner before described. All tile must be laid with full flush joints, plumb to a line, with horizontal beds uniformly level on each course. Fill all the joints and crevices between the tile and steel work with mortar well slushed in.

TYPE OF ARCH

The arches for the floors in general shall be   inch flat or segment arches (side) (end) construction. Skewbacks must be carefully bedded in place against beams.

BEAM TILE — The soffits of all beams to be protected with slabs of tile at least one inch in thickness.

ROOFS — The arches for the main roof are to be   inch segment or flat arches same as specified for the floors.

MINOR ROOFS — The roofs of pent houses, roof over projecting portion in second story, floor of bulkheads, and other portions indicated on details as book tile shall be made of three-inch (3-inch) book tile set in place between tee-irons.

Tee-iron to be furnished by the iron contractor.

PARTITIONS — All partitions must start on steel beams or on fire-proof floor arches.

Partitions shown on the plans to be built the thickness indicated in figures. If no dimensions are given, the following sizes will govern:

Partitions for all corridors and for partitions over 12 feet and up to 16 feet in height, to be 4 inches.

Partitions over 16 feet in height to be 5 or 6 inches, and all cross partitions, 12 feet or less, to be 3 inches. Partition walls to be built straight, true, plumb and well-bonded with proper "break-joint" bond on each alternate course, and all joints thoroughly flushed up with mortar, and to be well-wedged underneath fire-proof ceiling.

FURRING TILE — Where indicated on plans, 2-inch furring tiles are to be built against the outside walls of the building. These tiles are to be secured to the brick walls with tenpenny spikes on every second course, driven into the brick work at intervals not greater than 36 inches apart.

CURB WALL — The curb wall in basement shall be furred with three-inch (3-inch) tile extending up to the under side of the iron plate along edge of curb wall and properly fitting around all beams.

ROUGH FRAMES — The contractor for carpenter work will furnish and erect the rough wood frames at all openings in partitions and furring.

COLUMN COVERING — All column covering shall start in all cases directly from the tile floor arches.

Column covering shall be designed to properly fit the colums. All corners of square columns shall be left (square) (round).

Column covering to be wired (once) (twice) in each course in height or secured together with clasps. Blocks must be set to break joints.

NAILING BLOCKS — Furnish and set where required for nailing trim thick porous blocks which will receive and hold nails.

COVERING EXPOSED STEEL WORK

All girders, beams, channels, etc., that show below the under side of ceiling are to be incased on all sides with at least two (2) inch thickness of fire-proof tile secured to the steel in the usual manner. If required, special designs must be submitted to the architect.

BOXES FOR PLUMBING PIPES

All soil, vent, down-spout and water supply pipes shall be boxed in, using three-inch (3-inch) tile, starting from the floor tile in all cases. This boxing shall not be done until the pipes have been properly tested, and covered by another contractor. There shall be no openings into boxes except for outlets on the various floors. Where these outlets occur small wood frames furnished by carpenter shall be set by the fire-proofing contractor.

BULKHEADS

All bulkheads of first and second floors shall be built of 3-inch tile; the structural iron contractor furnishing all necessary tee-irons for the support of the tile.

See details for bulkhead treatment, and iron drawings for the supports.

Provide three-inch (3-inch) tile for the end of bulkhead where intersected by the entrance doors.

TOILET-ROOM FLOORS

All toilet-room floors, where shown on plans, shall be raised approximately...... inches with fire-proofing. Supports to be so arranged as to not interfere with the piping of these rooms.

PENT HOUSES

The contractor shall build the walls of pent houses with four-inch (4-inch) hard or glazed tile, laid up in Portland cement mortar, all joints to be thoroughly flushed.

Curbs of all skylights shall be built of 4-inch tile.

FLOOR STRIPS AND CONCRETE FILLING

After the floor arches have been set in place, and at such times as may be designated by the architect, the contractor for carpenter work will furnish and set the 2-inch by 3-inch wood floor strips required as nailing ground for the finished wood flooring, where wooden flooring is called for.

After the strips have been set, the fire-proofing contractor must fill in between the same with concrete filling; this concrete is to composed of one (1) part American Portland cement, of approved brand, and ten (10) parts broken tile, stone, gravel or fine, clean coal cinders, thoroughly mixed together dry, then tempered and mixed, and stamped in place. In no case shall cinder concrete be allowed to come in contact with structural steel.

FINALLY

Do everything necessary to finish the entire work in a thorough and substantial manner.

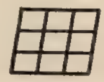
Remove promptly from the premises, all the tools, scaffolding, unused tile, debris, etc., as soon as the work is completed.

SAFE LOADS—SIDE-CONSTRUCTION FLAT ARCHES

Material, semi-porous. Blocks with webs ⅝ of an inch thick. Factor of safety, 7

LIGHT SECTIONS

6, 7, 8 and 9 inches



10 and 12 inches

15 inches

Note: In following table the weight of the arch blocks has been deducted from the safe load. The weight of cinder-fill, flooring and plastering must be deducted to obtain net live load.

The widest span permissible for any arch is indicated by cross rule in the column. Beyond this span it should only be used as a ceiling arch. The cross-sectional areas of arch blocks used in the following table are as follows: 6, 7, 8 and 9-inch blocks, 22.5 square inches; 10 and 12-inch blocks, 30 square inches; 15-inch blocks, 37.5 square inches.

For example: a 6-inch block has three horizontal webs, each ⅝ of an inch thick x 12 inches long, 3 x ⅝ x 12 inches = 22.5 square inches.

If thicker webs are used the loads given in table may be increased in direct proportion to increase of sectional area.

Dead loads of arches used as follows: 6-inch, 24 pounds; 7-inch, 25.5 pounds; 8-inch, 27 pounds; 9-inch, 29 pounds; 10-inch, 33.5 pounds; 12-inch, 37 pounds; 15-inch, 46 pounds.

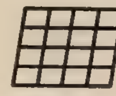
Spans Feet and Inches	6-inch Arch Pounds	7-inch Arch Pounds	8-inch Arch Pounds	9-inch Arch Pounds	10-inch Arch Pounds	12-inch Arch Pounds	15-inch Arch Pounds
1–6	1376	1608	1840	2000	2000	2000	2000
2–0	764	893	1023	1152	1717	2000	2000
2–6	480	563	645	727	1087	1307	2000
3–0	326	383	440	496	745	897	1412
3–3	275	323	371	419	630	759	1197
3–6	233	275	316	357	538	649	1025
3–9	200	236	272	307	465	561	887
4–0	173	204	236	267	404	488	774
4–3	151	178	206	233	354	429	681
4–6	132	156	181	204	312	378	602
4–9	116	137	159	181	277	336	536
5–0	102	122	141	160	247	299	479
5–3	91	108	126	143	221	268	430
5–6	...	96	112	127	198	241	388
5–9	...	86	100	114	179	217	351
6–0	...	77	90	102	161	197	319
6–3	...	...	81	92	146	178	290
6–6	...	...	73	83	132	162	265
6–9	...	...	66	75	120	148	242
7–0	...	...	...	68	110	135	222
7–6	...	...	...	55	91	113	187
8–0	...	...	...	...	76	94	159
8–6	...	...	...	...	.	80	136
9–0	...	...	...	...	...	67	116
10–0	...	...	...	...	...	47	85
11–0	...	...	...	...	...	...	62
12–0	...	...	...	...	...	...	45

SAFE LOADS—SIDE-CONSTRUCTION FLAT ARCHES

Material, semi-porous. Factor of safety, 7

HEAVY SECTIONS

6, 8, 9 and 10-inch Arch



12 and 15-inch Arch

Note: In following table the weight of arch blocks has been deducted from the safe load. The weight of cinder-fill, flooring and plastering must be deducted to obtain net live load.

The widest span permissible for any arch is indicated by cross rule in the column. Beyond this span it should be used only as a ceiling arch.

In table below, the depth of arches is given in first line, their cross-sectional area of 1 foot of block taken parallel to beams in second line, the span between beams in first column and safe loads in pounds in following columns.

The weights deducted as dead loads from each arch are as follows; 6-inch, 26 pounds; 7-inch, 28 pounds; 8-inch, 30.6 pounds; 9-inch, 31.2 pounds; 10-inch, 33.4 pounds; 12-inch, 38.3 pounds; 15-inch, 40.6 pounds.

Example: Required, the safe load of 12-inch arch, span 8 feet, using arch block having cross-sectional area of 31.5 square inches. Area of arch block used 38.5)31.5 = .82, which × 126 pounds = 103 pounds safe load required.

Example: Required, the safe load for 8-inch arch, span 5 feet 6 inches, with factor of safety of 5 instead of 7. 155 pounds + 30.6 pounds (dead load) = 185.6 × 7 = 1299.2 ÷ 5 = 259.8 — 30.6 = 229.2 pounds safe load required.

Arches	6 Inches	7 Inches	8 Inches	9 Inches	10 Inches	12 Inches	15 Inches
Areas	30 Square Inches	30 Square Inches	30 Square Inches	31.5 Square Inches	33 Square Inches	37.5 Square Inches	38 Square Inches
Spans Feet and Inches	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
1–6	1840	2148	2458	2500	2500	2500	2500
2–0	1022	1196	1369	1623	1892	2500	2500
2–6	645	754	865	1027	1199	1642	2087
3–0	439	515	592	704	822	1128	1437
3–3	370	434	500	595	696	956	1219
3–6	314	371	427	509	595	819	1045
3–9	270	320	368	439	514	708	905
4–0	234	276	319	382	448	618	791
4–3	204	243	280	335	393	543	696
4–6	178	213	246	296	347	480	616
4–9	158	188	218	262	308	427	549
5–0	140	167	193	233	275	382	491
5–3	124	149	173	209	246	343	442
5–6	...	133	155	188	221	309	399
5–9	...	118	139	169	200	279	362
6–0	...	107	125	153	181	253	329
6–3	...	...	113	138	164	231	300
6–6	...	...	102	125	149	210	274
6–9	...	...	92	114	136	192	251
7–0	...	...	...	104	124	176	231
7–6	...	...	...	86	104	148	196
8–0	...	...	...	...	87	126	167
8–6	...	...	...	...	...	107	144
9–0	...	...	...	...	...	91	124
9–6	...	...	...	...	...	78	107

SAFE LOADS—END AND COMBINATION-CONSTRUCTION FLAT ARCHES

Material, semi-porous. Factor of safety, 7

The following table is applicable to all shapes of blocks. The areas given are obtained by passing a plane through the blocks at right angles to all the webs (instead of parallel to the webs as in previous tables). Generally speaking, end-construction blocks of various shapes but of the same depth and cross-sectional area have equal strength.

The weight of the arch has *not* been deducted from safe loads in table below, therefore this and other dead load must be deducted to obtain the net safe live load for any arch and span.

Example: What load will an 8-inch arch carry with a factor of safety of 5 for a span of 5 feet 6 inches, the blocks having a sectional area parallel to the beams of 44.25 square inches (the webs being ¾ inch thick and three horizonal and four vertical)?

The area of 8-inch arch used in table is 37 square inches. 44.25÷37=1.19. Safe load given in table 228 × 1.19=271 pounds. Weight of arch =44.25 × 12=531 cubic inches × .06=say 32 pounds; 271—32=239 safe load per square foot for factor of safety of 7; 271 × 7=1897÷5=379—32=247 safe load per square foot for factor of safety of 5.

Arches	6 Inches	7 Inches	8 Inches	9 Inches	10 Inches	12 Inches	15 Inches
Areas	31 Square Inches	34 Square Inches	37 Square Inches	40 Square Inches	43 Square Inches	49 Square Inches	58 Square Inches
Spans Feet and Inches	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
1–6	1928	2468	3069	3733	4459	6097	9022
2–0	1085	1388	1726	2100	2508	3430	5075
2–6	694	888	1104	1344	1605	2195	3248
3–0	482	617	767	933	1114	1524	2255
3–3	410	525	654	795	950	1299	1922
3–6	354	453	563	685	819	1120	1657
3–9	308	394	491	597	713	975	1443
4–0	271	347	431	525	627	857	1268
4–3	240	307	382	465	555	759	1124
4–6	214	274	341	414	495	677	1002
4–9	192	246	306	372	444	608	900
5–0	173	222	276	336	401	548	812
5–3	157	201	250	304	364	497	736
5–6	143	183	228	277	331	453	671
5–9	131	168	208	254	303	415	614
6–0	120	154	191	233	278	381	563
6–3	111	142	176	215	256	351	519
6–6	...	131	163	198	237	324	480
6–9	...	121	151	184	220	301	445
7–0	...	113	140	171	204	280	414
7–6	...	...	122	149	178	243	360
8–0	...	...	107	131	156	214	317
8–6	...	...	...	116	138	190	281
9–0	...	...	...	103	123	169	250
9–6	...	...	...	...	111	152	225
10–0	...	...	...	...	100	137	203
10–6	...	...	...	...	...	124	184
11–0	...	...	...	...	..	113	167
11–6	. .	...	...	...	...	103	153
12–0	...	...	...	...	...	95	141

SAFE LOADS—SEGMENTAL ARCHES

Given for blocks with the following sectional areas (per foot of arch parallel with beams): 4-inch arch, 28 square inches; 6-inch, 36 square inches; 8-inch, 43 square inches; 10-inch, 47 square inches. Factor of safety, 7.

Note: The weight of the arch blocks has been deducted in table so that only the dead load of concrete fill, plastering, etc., must be deducted to obtain net live load.

Spans Feet and Inches	Rise Inches	4-inch Arch Lbs.	6-inch Arch Lbs.	8-inch Arch Lbs.	10-inch Arch Lbs.	Spans Feet and Inches	Rise Inches	4-inch Arch Lbs.	6-inch Arch Lbs.	8-inch Arch Lbs.	10-inch Arch Lbs.
4	¾	702	902	1078	1178	7-6	¾	366	471	563	615
	1	920	1184	1414	1545		1	482	621	741	810
	1¼	1155	1485	1774	1939		1¼	602	774	925	1011
	1½	1353	1740	2079	2272		1½	715	920	1099	1201
	1¾	1545	1986	2373	2593		1¾	815	1049	1253	1369
	2	1736	2233	2667	2915		2	915	1176	1405	1536
4-6	¾	616	792	946	1034	8	¾	341	439	525	573
	1	812	1044	1247	1363		1	457	588	703	768
	1¼	1020	1313	1568	1713		1¼	562	724	864	944
	1½	1196	1539	1838	2009		1½	668	859	1026	1122
	1¾	1381	1775	2121	2318		1¾	767	987	1179	1288
	2	1536	1975	2359	2578		2	854	1099	1312	1434
5	¾	551	709	847	926	8-6	¾	319	411	491	536
	1	744	957	1143	1249		1	428	551	658	719
	1¼	911	1172	1400	1530		1¼	527	678	810	885
	1½	1072	1379	1647	1800		1½	626	806	963	1052
	1¾	1238	1592	1902	2078		1¾	719	926	1106	1208
	2	1379	1773	2118	2315		2	807	1037	1239	1354
5-6	¾	499	641	766	837	9	¾	300	386	461	504
	1	672	864	1032	1128		1	403	518	619	677
	1¼	826	1062	1269	1387		1¼	501	645	770	842
	1½	984	1266	1512	1652		1½	590	758	906	990
	1¾	1119	1439	1719	1879		1¾	677	871	1041	1137
	2	1258	1619	1933	2113		2	759	977	1167	1275
6	¾	455	585	699	764	9-6	¾	283	364	435	475
	1	612	788	941	1028		1	380	489	584	638
	1¼	753	969	1157	1265		1¼	472	608	726	793
	1½	898	1154	1379	1507		1½	561	721	862	942
	1¾	1022	1315	1570	1716		1¾	639	823	983	1074
	2	1148	1476	1763	1927		2	717	923	1102	1204
6-6	¾	428	551	658	719	10	¾	267	344	411	449
	1	562	724	864	944		1	359	462	552	603
	1¼	701	902	1077	1177		1¼	447	576	688	751
	1½	823	1058	1264	1382		1½	531	683	816	892
	1¾	947	1218	1455	1590		1¾	610	784	937	1024
	2	1055	1358	1622	1772		2	683	879	1050	1147
7	¾	394	508	606	662	10-6	¾	257	331	396	432
	1	520	669	799	873		1	340	438	523	572
	1¼	648	834	996	1089		1¼	424	546	652	713
	1½	762	981	1171	1280		1½	504	648	774	846
	1¾	876	1127	1346	1471		1¾	579	744	889	972
	2	983	1264	1510	1650		2	647	832	994	1086

SAFE LOADS, SEGMENTAL ARCHES—*Continued*

Spans Feet and Inches	Rise Inches	4-inch Arch Lbs.	6-inch Arch Lbs.	8-inch Arch Lbs.	10-inch Arch Lbs.	Spans Feet and Inches	Rise Inches	4-inch Arch Lbs.	6-inch Arch Lbs.	8-inch Arch Lbs.	10-inch Arch Lbs.
11	¾	244	315	376	411	17	¾	151	194	232	254
	1	327	421	503	550		1	205	265	316	345
	1¼	404	519	621	678		1¼	256	330	394	430
	1½	479	617	737	805		1½	304	392	468	512
	1¾	551	709	847	925		1¾	351	452	540	590
	2	617	794	948	1036		2	393	506	605	661
11-6	¾	233	299	358	391	18	¾	141	182	218	238
	1	312	401	480	524		1	192	248	296	324
	1¼	388	499	596	652		1¼	240	310	370	404
	1½	460	592	707	773		1½	287	370	442	482
	1¾	528	680	812	887		1¾	330	425	507	554
	2	591	761	909	993		2	371	477	570	623
12	¾	222	285	341	372	19	¾	134	173	206	225
	1	297	383	458	500		1	181	233	279	304
	1¼	370	477	569	622		1¼	227	293	350	382
	1½	439	566	676	738		1½	271	348	416	455
	1¾	505	649	776	848		1¾	312	402	480	524
	2	565	727	869	949		2	351	451	539	589
12-6	¾	212	273	326	356	20	¾	126	163	194	212
	1	284	366	437	478		1	172	221	265	289
	1¼	354	456	545	595		1¼	215	277	331	361
	1½	420	541	646	706		1½	257	330	395	431
	1¾	483	621	742	811		1¾	296	381	455	497
	2	541	696	832	909		2	332	427	510	558
13	¾	203	261	312	341	21	¾	119	153	183	200
	1	272	351	419	458		1	163	209	250	273
	1¼	339	437	522	570		1¼	205	263	315	344
	1½	403	519	620	677		1½	243	314	375	409
	1¾	463	596	712	778		1¾	281	361	432	472
	2	521	670	801	875		2	315	406	485	530
14	¾	186	240	287	313	22	¾	113	145	174	190
	1	253	326	390	426		1	154	199	237	259
	1¼	315	406	485	530		1¼	194	250	298	326
	1½	374	482	575	629		1½	232	299	357	390
	1¾	430	553	661	722		1¾	268	344	412	450
	2	481	619	740	808		2	301	377	462	505
15	¾	174	225	268	293	23	¾	108	139	166	181
	1	234	302	361	394		1	147	190	227	247
	1¼	292	377	450	491		1¼	185	238	284	310
	1½	347	447	534	583		1½	221	284	340	371
	1¾	401	515	616	673		1¾	255	328	392	428
	2	449	577	690	754		2	286	369	440	481
16	¾	162	209	249	272	24	¾	102	132	157	172
	1	218	281	336	367		1	140	181	216	236
	1¼	274	353	421	460		1¼	177	227	272	297
	1½	325	419	500	546		1½	211	272	325	355
	1¾	374	481	575	628		1¾	244	314	375	410
	2	420	540	645	705		2	274	353	421	460

EXPLANATION OF TABLE ON PAGES 35 AND 36

The safe load in pounds per square foot uniformly distributed, is for a factor of safety of 7 for semi-porous material for blocks of sectional areas given at head of table. To obtain safe load of blocks of any other thickness, compute the cross-sectional area in compression per lineal foot of arch. Divide this area by the area of the block used in table. This will give the safe load coefficient for this special block. Multiply any weight given in table for the same depth of arch by this coefficient, and it will give the safe load for the special arch. The weights of the arch blocks have been deducted to give the table weights. Deduct other dead loads of concrete fill, plastering, etc., to obtain safe net load.

Example: what is the strength of a 6-inch segmental arch, span 7 feet, rise 1¼ inches per foot of span, side construction blocks having three horizontal webs ⅝ inch thick? Cross-sectional area equals ⅝ inch x 12 inches x 3 inches, equals 22.5 square inches, which divided by 36, equals .62, the coefficient. Therefore, 834 pounds given in table x .62 equals 519 pounds safe load required. If the arch blocks are used end construction, all the webs would be in compression, and the sectional area of a block with four vertical and three horizontal ribs x ⅝ inch thick, is 32.8 square inches, which divided by 36, equals .91 the coefficient. 834 x .91 equals 759 pounds.

The weights deducted for dead load of arches in table are as follows: 4-inch arch, 17.3 pounds; 6-inch, 21.6 pounds; 8-inch, 25.8 pounds; 10-inch, 28.5 pounds. To obtain weight of any block, multiply its cross-sectional area in square inches by 12 inches, equals cubic inches of material per lineal foot which multiplied by .06 pounds, equals weight required for semi-porous material.

WEIGHTS OF FLOOR CONSTRUCTION

THE weights given below are for typical sections and may be readily adapted to other conditions.

6-INCH FLAT ARCH

Flat arch in 6-inch beams, 4-foot 6-inch span

ARTIFICIAL STONE, ROCK ASPHALT OR FLOOR TILE

FINISHED FLOOR 1⅞ INCHES ABOVE I BEAMS

	Pounds
⅞-inch finish (140 pounds per cubic foot)	10.0
2-inch cinder concrete, lightly rammed (66 pounds per cubic foot)	11.0
6-inch side construction, T. C. flat arch (weight 20 to 26 pounds) say	24.0
⅝-inch plastering, brown and white coat	5.0
6-inch I beams, 12¼ pounds, 4-foot, 6-inch span	2.75
Total dead load	52.75

WOODEN FLOOR CONSTRUCTION

FINISHED FLOOR 2⅞ INCHES ABOVE I BEAMS

	Pounds
⅞-inch maple flooring	3.5
2 x 4-inch spruce sleepers, 16-inch centers, 2-inch cinder concrete fill between sleepers	8.5
1-inch cinder concrete from top of arch to top of beam, at 60 pounds per cubic foot	5.0
6-inch flat arch (20 to 26 pounds) say 24 pounds	24.0
⅝-inch plastering, brown and white coat	5.0
6-inch I beams, 12¼ pounds, 4-foot 6-inch span	2.75
Total thickness, 10½ inches.	
Total dead load	48.75

NOTE.—There is no difference between side and end construction, except the actual differences in weight of the terra cotta in the arches.

If rough under flooring is used, add ⅞ inches to total thickness and 3 pounds to total weight.

10-INCH ARCH

Flat arch in 12-inch I beams, about 6-foot span

ARTIFICIAL STONE, ROCK ASPHALT OR FLOOR TILE

FINISHED FLOOR 1⅞ INCHES ABOVE I BEAMS

	Pounds
⅞-inch finish	10
4-inch cinder concrete (lightly rammed, 66 pounds per cubic foot) over beams	22
10-inch flat arch, set 1 inch below bottom of beam (weight 28 to 38 pounds) say	36
⅝-inch plastering, brown and white coat	5
12-inch I beams, 31½ pounds, about 6-foot centers	5
Total thickness, 15½ inches.	——
Total dead load	78

12-INCH ARCH

If 12-inch arches are used instead of 10-inch

	Pounds
⅞-inch finish	10
2-inch cinder concrete	11
12-inch flat arch, set 1 inch below bottom of beam, weight, say .	40
⅝-inch plastering, brown and white coat	5
12-inch I beams	5
Total thickness, 15½ inches.	——
Total dead load	71

It is therefore apparent that deep arches are not only much stronger, but also lighter where concrete fill must be used over them. Terra cotta filler blocks are sometimes used to lighten the weight of concrete fill over arches. They add nothing to the strength of the arch and are more expensive than the deeper arch blocks of equal depth. For example, a 10-inch arch with 2-inch T. C. filler over it is weaker and more expensive than a 12-inch arch.

If 12-inch arch as above, used with wooden flooring finished 2⅞ inches above top of beams, the total depth will be 16½ inches, and total dead load 67 pounds per square foot.

6-INCH SEGMENTAL ARCH

CEMENT, asphalt, or tile finish, 12-inch I's, 6-foot span, 1-inch per foot rise. Top of arch level with top of beams, haunches filled with cinder concrete. Using the following example as a guide, any arch may be readily computed for various conditions.

	Pounds
⅞-inch cement, asphalt or tile finish	10.0
3-inch cinder concrete (2 inches average depth to top of beams and 1 inch over the top) at 66 pounds	16.5
6-inch segmental arch, say 25 pounds per square foot . . .	25.0
⅝-inch plastering, brown and white coat	5.0
12-inch I beam, 31½ pounds	5.0
Total dead load	61.5

Wooden flooring finished 2⅞ inches above beams.

	Pounds
⅞-inch wood flooring	3.5
2 x 4-inch sleepers with cinder concrete between them . . .	8.5
2-inch cinder concrete to level of top of beams	11.0
6-inch segment arch	25.0
⅝-inch plastering, brown and white coat	5.0
12-inch I beam, 31½ pounds	5.0
Total dead load	58.0

Same as above but with flat metal lath ceiling and scratch, brown and white coat plastering, 10 pounds. Total dead load will be 63 pounds.

6-INCH "NEW YORK" REINFORCED FLAT ARCH

Cement, asphalt or tile finish 1⅞ inches above top of 10-inch I's, 6-foot span. Top of T. C. arch level with top of beams.

	Pounds
⅞-inch cement, asphalt or tile finish	10.0
1-inch cinder concrete at 66 pounds	5.5
6-inch New York arch, including cement mortar	23.0
2-inch beam blocks, supporting arch	3.0
Plastered ceiling two coat work	5.0
10-inch I beams, 25 pounds	4.0
Total weight	50.5

For weights of various depths of arches see bottom of page 16.

NOTE.—The 6-inch "New York" arch with paneled ceiling is 7 pounds per square foot lighter than any 4-inch flat, reinforced concrete paneled arch, and the 8-inch T. C. arch set level on bottom and filled with dry cinders is 18 pounds per square foot lighter than similar concrete construction. Cinder concrete for arches made according to regulations of New York building law weighs 90 pounds per cubic foot, 4 inches weighs 30 pounds and "New York" 6-inch arch 23 pounds. 8-inch "New York" arch weighs 28 pounds; 4-inch concrete 30 pounds and 4-inch dry cinders over it 16 pounds, or 46 pounds for 8 inches.

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CATALOGUE STANDARD FIREPROOF CONSTRUCTION—Showing standard methods of fireproofing steel frame buildings

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